Nuclear workers from Bulgaria pose for a picture after practicing how to load spent fuel casks into transport trucks.

Globetrotters: Three INL scientists help secure, return international nuclear fuel supplies

by Ethan Huffman, *INL Communications*

Idaho National Laboratory engineers Igor Bolshinsky, Mike Tyacke and Ken Allen have grown accustomed to international travel. In the last six years, they have logged thousands of air miles, spent hundreds of days implementing international agreements and processes, and routinely subjected themselves to highly sensitive national security missions.

Their goal? To prevent the theft of highly-enriched uranium nuclear fuel by helping a handful of central European countries ship and transport it to a more safe location in Russia for reprocessing.

Since 2002, the trio of engineers has assisted the National Nuclear Security Administration (NNSA) by overseeing and implementing a series of lengthy and complex agreements, legal proceedings and international shipping requirements previously negotiated and agreed upon by the fuel's host nation, NNSA, and the U.S. State Department.

Working alongside professionals from the International Atomic Energy Agency (IAEA) and two other national laboratories, INL has helped remove more than 760 kilograms of fresh and spent Highly Enriched Uranium (HEU) fuel from 12 nations, including the Czech Republic, Libya and Vietnam. The fuel – enough to make more than 30 nuclear bombs – has since been returned to Russia for reprocessing and down blending.

How it began
During the bitterly contentious Cold War era that pitted the U.S. and Russia in a technological, economic and military race, countries such as Poland, Hungary and Bulgaria were among the more than 15 nations that participated in a Russian nuclear fuel exchange program.

During this period, Russia sent thousands of pounds of fresh, highly-enriched uranium fuel for use in small reactors designed for scientific study in medical, agricultural and energy technologies.

Officials from the International Atomic Energy Agency and Euratom place tamper-evident seals on the fuel casks.

Around the same time, the United States operated a similar program known as Atoms for Peace. Under this plan, the U.S. also provided fuel to ally nations who agreed to return it once it was irradiated in a research reactor. To ensure accountability for the fuel, the U.S. recommended and supported the creation of the intergovernmental oversight agency known as the IAEA.

With a fuel exchange program and oversight agency in place, developing nations were able to power research reactors without the need for a significant investment in fuel development, reprocessing capabilities or storage.

The idea behind Atoms for Peace was to encourage peaceful, worldwide uses of nuclear technology, while simultaneously fostering and promoting global security. Leaders from dozens of countries supported the plan, believing its success would protect against the proliferation of nuclear weapons while also helping ease the minds of a public that just a few years earlier had witnessed atomic power destroy Hiroshima and Nagasaki, Japan.

In the four decades that followed, the IAEA closely monitored the nations receiving both the U.S. and Russian fuel supplies to ensure safety and accountability. But when the Soviet Union collapsed in 1991, the same countries that had taken in Russian fuel were suddenly left without a location or process for returning it.

Many of the fuel-receiving countries were inadequately prepared to handle and provide long-term storage for the HEU fuel, and it quickly became more of a burden than a benefit. It also created a new national security risk for the U.S., which feared it might fall into the wrong hands.

The Russian Research Reactor Fuel Return program
By the time the Atoms for Peace project was proposed, scientists at INL were fully aware of nuclear energy's potential. In 1951, the laboratory made history, becoming the first organization to create electricity from a nuclear reactor. By 1955, the laboratory had powered a small city using

only nuclear power.

The first of several fuel casks is lifted via crane and moved into position for transport.

In the six decades since, INL scientists have designed, constructed and operated 52 reactors, mostly first of their kind. Along the way, the lab helped the Navy design the first nuclear-powered submarine, and constructed and continues to operate the world's most advanced materials test reactor.

Over the years, the nuclear expertise that has percolated from INL has influenced the design of every reactor built in the country. It has also led to a keen understanding of the best methods, tactics and procedures for securing, handling and transporting nuclear fuels.

In 2000, the Department of Energy began looking for a team of experts to lead an international fuel recovery effort called the Russian Research Reactor Fuel Return Program. The mandate — directed by Congress and managed by the National Nuclear Security Administration — was both complex and potentially dangerous. Those selected would spend much of their time ensuring that international agreements to secure and transport HEU fuel supplies from the host nations back to Russia were completed on time, within budget and in a manner that ensured the safety and security of all parties and countries involved.

Though seemingly controversial, returning the fuel to Russia is actually the best security option because it ensures the fuel will be quickly down blended to a proliferation-resistant material.

Initially, DOE picked Idaho's Bolshinsky to be the technical and negotiation lead for NNSA. Bolshinsky, a Ukrainian immigrant with a profound knowledge of foreign policy and national security, brought both the engineering skills and cultural background to the negotiation process. Over the next few years, NNSA added Idaho engineers Mike Tyacke and Ken Allen, along with two employees from the Savannah River Site, and one from Oak Ridge National Laboratory.

Together, the six engineers work day in and day out through a lengthy process of international agreements, shipping licenses and security protocols that often involve years of planning, logistics and legal agreements.

Three steps to shipping the fuel

Depending on the type and quantity of fuel that needs to be recovered, missions can take anywhere from several months to several years to complete. The most challenging and time-consuming part of the process involves the legal and political agreements that must be put into place and mutually agreed upon by both the U.S. and the country in possession of the fuel. In many cases, the agreements must be ratified by the host nation's parliamentary process.

The agreements cover a gamut of issues essential to any technical operation. Concerns over liability, security and transportation must be drawn up in detailed form and confirmed by multiple parties. And since every country has its own unique laws and jurisdictions, this process can take years to complete. The time delay is counterproductive when compared to the urgency of the situation, so multiple shipping projects are ongoing in numerous countries around the world. At each location, an NNSA representative, often accompanied by INL's Bolshinsky, is heavily engaged.

Workers guide the fuel casks onto a truck bed and prepare to load it into a container.

A typical recovery mission involves three steps. First, representatives from NNSA and the fuel-holding country meet to discuss the conditions of the program. Since the fuel recovery effort is meant to decrease current and future proliferation concerns, each country must agree to either permanently shut down its reactor, or convert it to use low-enriched fuel that can't be used for making nuclear weapons. It is at these initial meetings that Bolshinsky is especially valuable.

During the initial phase, engineers also tour the facility housing the fuel. It's their first in-depth look at the fuel's condition and the quantity that will be shipped back to Russia. Already, team members are analyzing the logistical challenges for loading and moving the shipping casks.

Czech Republic workers check seals and measure radiation readings before

Next, INL's Tyacke and Allen hold a series of technical meetings with the host nation to establish timelines for starting and completing a range of important tasks. Items discussed include everything from determining the number of casks necessary for the shipment, to equipment purchases necessary to upgrade the facility for LEU operations. Further complicating things is the reality that HEU fuel cannot be airlifted. This means that the fuel must travel by truck, train, ship and anything else with wheels over thousands of miles before finally reaching Russia.

With a highly sensitive load and series of tight deadlines to follow, even the smallest items can derail the project and cause delays. But the details are essential to each operation. Back in Idaho, Allen's office holds a half-dozen three-inch binders filled with documentation, timelines and equipment purchase agreements. Each binder represents a different fuel shipment from a different part of the world.

Depending on terms of the negotiation, fuel shipments can consist of a few casks to several dozen. And for every country the fuel passes through, a new international agreement, liability clause and security detail must be created, vetted and approved.

This phase also includes a series of training sessions in which nuclear facility workers from the host nation work alongside Tyacke and Allen to ensure they are well-practiced in the process and technique for lifting and loading the fuel casks into a container and onto a small convoy of transport trucks.

loading fuel casks into cargo containers.

In the days and hours before the fuel is moved, intense security measures are put into place. Closed-circuit video monitors the fuel facility 24 hours a day. Tamper-evident seals certified by the IAEA are placed on each cask, and armed guards roam around the location. The heightened status will remain from the time the fuel leaves the host nation until it arrives in Russia.

Finally, once all the agreements are in place and security and transportation measures have been prepared, the fuel is ready to be moved.

Recent shipment

Last December, in the middle of the night, the INL scientists, experts from the IAEA and NNSA, and several dozen workers and security employees from the Czech Republic gathered outside a storage warehouse near Prague, Czech Republic.

Throughout the night, they worked to fill 16 fuel casks with spent HEU fuel and load them into the back of eight specially designed transport trucks. Before a single cask was loaded, it was measured for radiation limits, checked for safety, and inspected for any possible security breach. After each cask was loaded, the evaluation process was repeated.

As daylight approached, the trucks – in tight formation under police escort – left the warehouse and traveled quickly to a nearby train station. Over the next several hours, the casks were lifted onto a train, secured and evaluated again. The process took all day, and many of the workers didn't sleep. Nearly 24 hours after the casks were loaded onto trucks, the train pulled away from the station en route to Russia.

The shipment in December was part of a multiyear mission in the Czech Republic to remove HEU fuel from the region. The INL engineers, NNSA and the IAEA will be back again soon to start another round of fuel shipments. Eventually, the nation will be able to join the growing list of countries that have returned all HEU and are now more safe.

In June, the team also wrapped up a multiyear mission by removing nearly 30 pounds of HEU spent fuel from Latvia. A month later, the team was in Bulgaria securing and transporting 14 pounds.

And just last month, the INL team helped return the largest foreign fuel shipment ever: 341 pounds of HEU fuel sorted into 13 casks transported from a nuclear facility in Hungary to Russia.

Read an ABC News Nightline story about this work from 2005.

Feature Archive